

CLAIMS

1. An electron exposure apparatus comprising:

a plurality of tips;

a plurality of springs for respectively holding  
said plurality of tips;

5 a holder for collectively holding said springs for  
said plurality of tips;

a coarse mechanism for moving said holder to allow  
said plurality of tips to relatively approach a wafer  
whose surface is covered with a resist layer to be  
10 subjected to electron exposure;

a transfer mechanism for correcting inclinations  
of the tips at ends, of said plurality of tips toward  
the wafer;

a drive mechanism for relatively X-Y driving the  
15 wafer and said plurality of tips on the surface of the  
wafer;

a control device for controlling said respective  
mechanisms;

a device for supplying currents to said plurality  
20 of tips;

means for detecting the currents supplied to said  
plurality of tips;

a control device for allowing target values of the  
currents supplied to said plurality of tips to coincide  
25 with detected values; and

a pattern input device for supplying a target  
value corresponding to an electron-exposure pattern to

said each control device.

2. An electron exposure apparatus according to claim 1, wherein said plurality of tips are arranged in a row at predetermined intervals, and the tips located at both ends of these tips are used to correct  
5 inclinations toward the wafer and control distances between the tips being under electron exposure and the wafer and other tips thereof are used for electron exposure.

3. An electron exposure apparatus according to claim 1, wherein said plurality of tips are arranged on an X-Y plane at predetermined intervals, and the tips located at three ends of these tips are used to correct  
5 inclinations toward the wafer and control distances between the tips being under electron exposure and the wafer and other tips thereof are used for electron exposure.

4. An electron exposure apparatus according to claim 2, wherein displacements of the tips used to correct inclinations toward the wafer and control distances between the tips being under electron exposure  
5 and the wafer are detected by currents.

5. An electron exposure apparatus according to claim 2, wherein displacements of the tips used to correct inclinations toward the wafer and control distances between the tips being under electron exposure  
5 and the wafer are detected by an optical lever deflection sensor type atomic force microscope.

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6. An electron exposure apparatus according to claim 2, wherein displacements of the tips used to correct inclinations toward the wafer and control distances between the tips being under electron exposure and the wafer are detected by changes in capacitances between electrodes placed on the backs of cantilevers and the cantilevers.

7. An electron exposure apparatus according to claim 3, wherein displacements of the tips used to correct inclinations toward the wafer and control distances between the tips being under electron exposure and the wafer are detected by currents.

8. An electron exposure apparatus according to claim 3, wherein displacements of the tips used to correct inclinations toward the wafer and control distances between the tips being under electron exposure and the wafer are detected by an optical lever deflection sensor type atomic force microscope.

9. An electron exposure apparatus according to claim 3, wherein displacements of the tips used to correct inclinations toward the wafer and control distances between the tips being under electron exposure and the wafer are detected by changes in capacitances between electrodes placed on the backs of cantilevers and the cantilevers.

10. An electron exposure apparatus according to claim 2, wherein currents supplied to the tips used for electron exposure are set to values different from one

another at a latent-image creation portion and a latent-  
5 image non-creation portion.

11. An electron exposure apparatus according to  
claim 3, wherein currents supplied to the tips used for  
electron exposure are set to values different from one  
another at a latent-image creation portion and a latent-  
5 image non-creation portion.

12. An electron exposure apparatus comprising:  
a plurality of one-dimensionally arranged tips;  
a plurality of springs for respectively holding  
said plurality of tips;

5 a holder for collectively holding said springs for  
said plurality of tips;

a coarse mechanism for moving said holder to allow  
said plurality of tips to relatively approach a wafer  
whose surface is covered with a resist layer to be  
10 subjected to electron exposure;

a transfer mechanism for correcting inclinations  
of the tips at ends, of said plurality of tips toward  
the wafer;

a drive mechanism for driving the wafer rotatably  
15 about said tips;

a control device for controlling said respective  
mechanisms;

a device for supplying currents to said plurality  
of tips;

20 means for detecting the currents supplied to said  
plurality of tips;

a control device for allowing target values of the currents supplied to said plurality of tips to coincide with detected values; and

25        a pattern input device for supplying a target value corresponding to an electron-exposure pattern to said each control device.

13. An electron exposure apparatus according to claim 12, wherein the tips located at both ends, of said plurality of tips are used to correct inclinations toward the wafer and control distances between the tips  
5        being under electron exposure and the wafer and other tips thereof are used for electron exposure.

14. An electron exposure apparatus comprising:

a plurality of tips;

a plurality of springs for respectively holding said plurality of tips;

5        a holder for collectively holding said springs for said plurality of tips;

a coarse mechanism for moving said holder to thereby allow said tips to relatively approach a wafer whose surface is covered with a resist layer to be  
10        subjected to electron exposure;

a transfer mechanism for correcting inclinations of the tips at ends, of said plurality of tips toward the wafer;

a drive mechanism for relatively X-Y driving the  
15        wafer and said plurality of tips on the surface of the wafer;

a control device for controlling said respective mechanisms;

a device for supplying currents to said plurality  
20 of tips;

means for detecting the currents supplied to said plurality of tips;

a control device for allowing target values of the currents supplied to said plurality of tips to coincide  
25 with detected values; and

a pattern input device for supplying a target value corresponding to an electron-exposure pattern to said each control device;

wherein said tips are formed at leading ends of  
30 movable portions of an electromechanical transducer having a plurality of electrostatic actuators formed on one substrate, one of said two actuators being a cascade structure in which a fixed electrode is formed in association with a movable electrode of the other  
35 actuator and being capable of driving a movable electrode in intersecting two-axis directions.

15. An electron exposure apparatus according to claim 14, wherein said plurality of tips are arranged in a row at predetermined intervals, and the tips located at both ends of these tips are used to correct  
5 inclinations toward the wafer and control distances between the tips being under electron exposure and the wafer and other tips thereof are used for electron exposure.

16. An electron exposure apparatus according to claim 14, wherein said plurality of tips are arranged on an X-Y plane at predetermined intervals, and the tips located at three ends of these tips are used to correct  
5 inclinations toward the wafer and control distances between the tips being under electron exposure and the wafer and other tips thereof are used for electron exposure.

17. An electron exposure apparatus according to claim 15, wherein displacements of the tips used to correct inclinations toward the wafer and control  
5 distances between the tips being under electron exposure and the wafer are detected by currents.

18. An electron exposure apparatus according to claim 16, wherein displacements of the tips used to correct inclinations toward the wafer and control  
5 distances between the tips being under electron exposure and the wafer are detected by currents.

19. An electron exposure apparatus according to claim 14, wherein currents supplied to the tips used for electron exposure are set to values different from one  
5 another at a latent-image creation portion and a latent-image non-creation portion.

20. An electron exposure apparatus according to claim 15, wherein currents supplied to the tips used for electron exposure are set to values different from one  
5 another at a latent-image creation portion and a latent-image non-creation portion.

21. An electron exposure apparatus comprising:

a plurality of tips;

a plurality of springs for respectively holding  
said plurality of tips;

5 a holder for collectively holding said springs for  
said plurality of tips;

a coarse mechanism for moving said holder to  
thereby allow said plurality of tips to relatively  
approach a wafer whose surface is covered with a resist  
10 layer to be subjected to electron exposure;

a slider for holding relative positions of said  
holder and the wafer in a state of being interposed  
between said holder and the wafer whose surface is  
covered with the resist layer;

15 a drive mechanism for relatively X-Y driving the  
wafer and said plurality of tips on the surface of the  
wafer;

a control device for controlling said respective  
mechanisms;

20 a device for supplying currents to said plurality  
of tips;

means for detecting the currents supplied to said  
plurality of tips;

a control device for allowing target values of the  
25 currents supplied to said plurality of tips to coincide  
with detected values; and

a pattern input device for supplying a target  
value corresponding to an electron-exposure pattern to



said each control device.

22. An electron exposure apparatus according to claim 21, wherein said plurality of tips are arranged in a row at predetermined intervals, and capacitances between electrodes of these tips, which are provided at both ends of said holder, and a conductor portion of said wafer are used to correct inclinations of said tips toward the wafer and control distances between the tips being under electron exposure and the wafer.

23. An electron exposure apparatus according to claim 21, wherein said plurality of tips are arranged on an X-Y plane at predetermined intervals, and capacitances between electrodes of these tips, which are provided at three ends of said holder, and a conductor portion of said wafer are used to correct inclinations of said tips toward the wafer and control distances between the tips being under electron exposure and the wafer.